SD11
.A11
F6
1937
Jan.

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

FOREST RESEARCH ACTIVITIES

FOREST MANAGEMENT
WATERSHED MANAGEMENT
FOREST PRODUCTS

FOREST ECONOMICS
RANGE MANAGEMENT
FOREST SURVEY

M—5105 (Rev. 1935)

FOREST RESEARCH

MONTHLY REPORT

January, 1937

copies given SI SR for FI

FOREST RESEARCH

MONTHLY REPORT

January, 1937

CONTENTS

	Page
General	1
Forest Management	
Silviculture	2
Regeneration	15
Mensuration	19
Protection	20
Naval Stores	26
Forest Economics	
Land Use	27
Logging	29
Forest Survey	30
Forest Influences	33
Forest Products	37
Range Management	40
Manuscripts	50
Translations	53

GENERAL

Allegheny

Glaze Damage on Kane Experimental Forest. Elevation had a great deal to do with the degree of damage caused by the glaze storm of last March, according to last summer's recruise of the Kane Experimental Forest. Below 1800 feet the damage was less than 2 1/2 percent, and from 2000 to 2100 feet it was over 30 percent. Black cherry suffered the highest percentage of damage, and hemlock the lowest. Damage was greatly influenced by crown position, the tallest trees unfortunately suffering the most heavily. Some 6,000 cords of wood are to be cut and sold from the Experimental Forest as a result of the damage. On certain areas the damage was so heavy that the usual process of marking was reversed, and only those trees were designated (by means of paint) which are to be left as seed-producers. Many of the seed trees were necessarily of the smaller diameters, and held a subordinate position in the stand.

Central States

Sleet Damage. Wide-spread damage to forest stands in southern Ohio, Indiana, Illinois, Missouri, Kentucky, Tennessee, and northern Arkansas occurred during January, as a result of sleet storms. In southern Ohio and Indiana coniferous plantations appeared most seriously affected. In Missouri and Arkansas, much breakage occurred in both hardwood and coniferous stands. In southern Illinois, C. E. Sutton reports a minimum of damage as a result of a warm thaw following the sleet storm. E. R. Green states that considerable damage to timber occurred on the Sylamore Experimental Forest in Arkansas, where roads are blocked and telephone lines are damaged by broken limbs and trees.

Missouri Report. The Station has been invited to participate in preparing a comprehensive report on conservation in Missouri, in cooperation with other state and federal agencies, for the benefit of the new Conservation Department to be established as a result of the referendum held at the last election.

Northern Rocky Mountain

Training in Statistical Methods is proceeding along a double front at this Station this winter. Every Tuesday morning a seminar is held to discuss various statistical problems. Emphasis is placed on the application of statistical methods to actual problems and the interpretation of results. A working knowledge of mechanics is assumed. Four meetings have been held on phases of experimental design. Correlation analysis and related problems are now up for discussion. For those in the Station who have not had statistical training a special class is held after hours on Tuesdays to give instruction in the

theory and computation of statistics. Practical problems are worked out in detail.

FOREST MANAGEMENT

SILVICULTURE

Allegheny

Weeding: Birch-Beech-Maple-Hemlock. The weeding study made last summer in very young stands, together with the study of 2 years ago in much older stands, have clearly demonstrated that weedings and thinnings are not a cure-all for inadequate stocking with crop trees and for poor composition; sufficient crop trees of the best species may be assured only by careful reproduction cuttings in the previous stand. It is planned in the future to thin half of each weeded plot and half of each check plot. The object is to determine the relative merit of (1) early weeding, (2) weeding plus a later thinning, and (3) thinning deferred until the cut material is salable. A proposed study of pruning crop trees in weeded northern hardwood stands has been outlined.

Deer and Rabbit Damage: Birch-Beech-Maple-Hemlock. Analysis by Ostrom of the large volume of data obtained last summer from 4 fenced exclosures and adjacent check areas shows that deer and rabbit injury is almost negligible in the old-growth hardwood stands on the Kane Forest, but is very considerable in second-growth stands and in the open:

Plot location	Proportion of Reproduction Injured	
	by Deer	by Rabbits
	(Percent of Total No.)	
Old growth stand	0.1	1
Second growth, lower slope	47	6
Second growth, plateau	26	15
Open (Frost pocket)	20	23

Black cherry, hemlock, and red maple were the species most frequently browsed by deer; rabbits seemed to show a preference for red maple and a particular dislike for hemlock. (Hemlock in the oak type is by no means immune to rabbit injury.)

Thinning and Pruning: White Pine. Thinnings have been started in a mixture of planted white pine and tulip poplar on the Baltimore watershed. Stump analyses show that in the first ten years after planting the white pines, exclusive of trees now dead from suppression, attained a diameter of 5 to 7 inches, whereas the tulip poplars grew

Allegheny (Continued)

only 1 to 3 inches in the same period. In the following 15 years there was a gradual or sudden tapering off in the pine growth rate, whereas the tulip poplars show a constant yearly increase up to 1 inch a year. A pruning study, which includes a test of variety of pruning tools and techniques, will be conducted on the same area. Mollenhauer prophesies that all slash will be disintegrated within 2 or 3 years, and believes that the tulip poplar leaves "act as a kind of catalyst in starting and speeding decay".

Appalachian

Pruning: White Pine. The establishment report for the white pine pruning study now under way on the Toccoa Experimental Forest has been completed by Junior Forester James F. Renshaw. The stand is 20 years old; the trees range from 2 to 7 inches in diameter and from 15 to 50 feet in height. Average actual pruning time varied from 1.91 minutes on lightly pruned trees to 3.26 minutes on heavily pruned trees. The average walking time between trees was 3 1/2 minutes. Maximum height to which trees were pruned varied from 22 feet in the tallest of the lightly pruned trees to 32 feet in the tallest of those heavily pruned. The primary objective of this study is to determine what proportion of the living whorls can be removed without seriously interfering with the growth rate of the trees. Four hundred test trees were used.

Toccoa Experimental Forest Enlarged. A recent addition has increased the area of the Toccoa Experimental Forest by approximately 1,400 acres, according to the new boundary traverse and computation of area completed by Junior Forester L. C. Maisenhelder of the Chattahoochee National Forest. Federal ownership and experiment station administration have been extended to an entire watershed.

Tree Class Study. Certain phases of analysis of the so-called "tree class" study, limited for the past year to white oak were completed by Barrett. This is an exploratory study to determine which of certain easily recognized tree characteristics will best express current increment, and whether or not a method can be derived for determining current increment quickly and with sufficient accuracy for practical use. A search is now under way for independent variables which will remove differences due to different locations.

Dogwood Sprouting Study. Buell completed analyses of measurements made during November, 1936, on sprouts from dogwood stumps cut at 12 different periods during 1934 and 1935, showing significant differences in the sprouting capacities of the stumps cut at the different periods. Twenty-seven blocks were laid out on the Bent Creek Experimental Forest in the spring of 1934, and in each block 12 dogwoods, 1 or 2 inches in diameter, were tagged. One tree in each block was cut March 1, another April 1, and others every 2 weeks thereafter until July 1; others were cut the first of August, September, and

Appalachian (Continued)

November, and the twelfth tree was cut the following February. Observation made in November of last year includes: the total length of sprouts produced, the maximum height of the sprouts, the average height of the dominant sprouts, and the average diameter of the sprout clumps. Significant differences between periods of cutting are shown for all these measurements in the following table:

Date of cutting	Mar. 1 1934	Apr. 1	Apr. 15	May 1	May 15	June 1	June 15	July 1	Aug. 1	Sept. 1	Nov. 1	Feb. 15 1935
Total length of sprouts	Average of 27 measurements - feet											
	43.0	37.0	31.2	33.0	28.1	21.8	21.5	19.8	28.2	39.0	34.6	37.4
Max. height of sprouts	5.8	5.8	5.2	5.4	3.8	3.4	3.0	2.8	2.6	3.2	4.0	3.6
Av.height dominant sprout	5.2	5.1	4.6	4.9	3.4	2.8	2.7	2.4	2.3	2.9	3.5	3.3
Av. diam. sprout clump	3.3	3.2	2.7	3.1	2.3	1.9	1.8	1.8	1.7	2.2	2.4	2.4

As the table shows, each of these measurements is least for stumps cut during July or August. The sprouts from stumps cut during November and February have had one less growing season than those cut in March. During 1937 it is planned to measure each group of sprouts on the third anniversary of the cutting of the trees to determine whether the differences in sprouting capacity are due merely to the greater period of growth available to some samples than others or to some other combination of factors correlated with the time of cutting.

Forest Type Maps: Examples for St. Louis Meeting of Biologists. For a meeting of Biological Survey research men, to be held in St. Louis early in March, the Station has been asked to prepare a series of cover type maps as samples of the current type mapping done by foresters and also to show the trends which type mapping may possibly take in the future. The Survey is interested in standardizing cover types and typing methods for wild life management purposes and is also interested in the foresters' approach to this question. In one of the experimental forests which will be used as a sample, two type maps are being prepared, the first showing the types as they are now mapped on national forests for timber management plans, the second showing the breakdown of the currently used types into those species associations found to be important as a result of the permanent forest inventory plots established during the past three years. Stand tables by individual species for these sub-types will accompany the maps to indicate in part the possible game food values of the various species associations.

California

Brush Invasion of Cut-over Areas: Pine Region. In 1923 an experiment was begun to test the efficiency of detailed maps as records of brush invasion of sale areas at Stanislaus Branch. Some 53 acres in six plots have been charted. With two exceptions, the plots were mapped before logging, immediately after logging, and five years after logging. One plot was mapped immediately after and ten years after logging, and one plot represents a heavy stand of virgin timber. The maps show the portions of the area of soil free of vegetation but capable of restocking, the portions occupied by rocks, logs, etc., which exclude stocking, the portions occupied by low brush, such as Chamaebatia, the portions occupied by higher brush, such as Ceanothus and manzanita, and other features.

The results in 1936 indicate that such maps furnish useful records which are consistent and can be subjected to statistical treatment. The classes of surface conditions can be defined so that an experienced man can map consistently in different years, or different men mapping the same area in the same year obtain reasonably similar results.

The comparisons indicate that five years after logging the proportions of the area occupied by brush is two to three times as great as immediately after logging, and ten years after logging the proportion may be six times as great as immediately after logging. The greatest increase has been in skid trails, on disturbed soil, and where slash was burned. Ceanothus parvifolius, which was very inconspicuous in the original stand, has spread rapidly over disturbed areas, and shows convincingly that the behavior of brush species must be known and considered in marking.

Forest Management: Redwood. Logging data collected during the last 3 field seasons are now in shape for release to interested lumbermen. An article entitled "The Importance of Large Loads in Redwood Logging", by Stahelin and Hallin, will appear in an early issue of the West Coast Lumberman and advance, mimeograph copies are being sent to redwood lumbermen by the California Redwood Association. Curves of trip-time with respect to size of load; and tables showing time saved by making 1 trip instead of 2 for a given volume, and time available for building up optimum loads at various distances from the landing are included for 3 of the tractor settings studied. The latest and biggest Caterpillar and Allis-Chalmers gas and diesel tractors were timed on these settings. Material is also being supplied to manufacturers of tractors and auxiliary equipment, at their request, on the performance of their machines.

Final curves of cost per MBM with respect to both log size and yarding distance have been completed for 3 slackline, 2 highlead and 7 tractor settings. These will be supplied to the companies which cooperated in the studies for their immediate use in advance of publication.

California (Continued)

A large amount of data was collected on the Henry Creek natural reproduction study and most of this material has been transferred to cards. A preliminary analysis of some of the residual tree and stocking figures has just been completed. These data were taken from 3 large, extensive plots selected to provide sampling of the different conditions found on the 55-acre selectively logged area. The stocking figures are from 328 mechanically selected reproduction quadrats and the seed trees determined by a 100 per inventory of the 3 large plots. Area A was tractor logged and lightly cut and the damage to standing trees and amount of area burned over in slash disposal was relatively small. Areas B and C were partly logged with double drum and marking, and logging and fire damage were heavier. Area B differed from both of the other plots in having a much higher percentage of white fir.

The number of seed trees per acre and the stocking, on the basis of percentage of milacre quadrats with 1 or more seedlings are shown in the following table.

This table supports an earlier contention that where selective logging is practiced the establishment of redwood seedlings is not a serious problem. It will be of value to determine the effect of severity of burn, type and density of vegetation, and other factors on both establishment and growth of seedlings.

Seed trees per acre and stocking density on Henry Creek sample areas.

Species	A		B		C		Average all areas	
	Seed trees	Stocking	Seed trees	Stocking	Seed trees	Stocking	Seed trees	Stocking
	Per acre	Percent	Per acre	Percent	Per acre	Percent	Per acre	Percent
Redwood	16.8	85.7	6.9	94.5	11.5	100.0	12.4	93.3
Douglas fir	6.0	40.0	2.6	22.2	3.9	54.0	4.4	44.5
White fir	1.6	30.0	3.4	55.6	0	17.1	1.7	26.9
Total	24.4	87.2	12.9	100.0	15.4	100.0	18.7	94.5

Central States

Missouri Defect Study. Compilation of the defect study data for the Clark Purchase Units was continued by G. A. Limstrom and John Kuenzel during January. Analysis of 500 trees from 15 representative areas showed that 69 percent of all trees had been fire scarred at some time, and that about 70 percent of the scarred trees of all species were defective. The total cull for trees of sawtimber size, (10" D.B.H. and over) was 32 percent of the merchantable volume. Eleven percent of the cull was found to be due to decay from fire scars, 18 percent due

to branch stub decay, and 6 percent due to miscellaneous causes, including butt rot, insect and other injuries.

Dr. G. H. Hepting and R. M. Lindgren of the Division of Forest Pathology conferred with station members on this project. Ross W. Davidson of the same office provided a list of decay organisms associated with various types of defect found in Missouri species. Dr. Ralph C. Hall identified insect specimens found in the course of field analysis.

Data from the Gardner Purchase Unit represent analysis of defective trees cut during stand improvement measures. These data do not provide a basis for determining cull percent, but will be useful to show the condition of certain trees having apparent defect.

Lake States

Growth and Mortality After Partial Cutting. The ten-year measurement of the 22-inch diameter limit cutting (29 percent of the volume removed in the form of overmature and defective trees) on the Upper Peninsula Experimental Forest shows that the annual net volume growth for the ten-year period (approximately 224 board feet per acre) was not appreciably less than that for the first five years (245 board feet). Mortality remained about constant during the ten-year period, 25 to 30 board feet per acre per year. On the other hand, in the uncut virgin forest mortality increased from an average of 72 board feet during the first five years to 174 during the last five-year period, completely wiping out all growth during the latter period.

Pacific Northwest

Mortality After Selection Cutting: Ponderosa Pine. Results of a cruise made last fall of approximately 10,000 acres of selectively cut ponderosa pine were analyzed by Junior Forester Beeman. The situation revealed by these data indicates that western pine beetles and windfall are the important causes, in the order named, for residual tree mortality. Most of the losses from both wind and insects occurred in the mature codominant trees. The average annual mortality in the tract cut over from 1929 to 1935 was 0.5 percent of the volume but varied in different parts of the tract from 0.2 percent to 1.3 percent. The volume losses in white fir and larch on the area cruised were approximately five times greater than those for the ponderosa pine.

Pacific Northwest (Continued)

Timber Stand: Blue Mountain Experimental Forest. During January the office work on the intensive cruise of the Blue Mountain Experimental Forest was completed by Kolbe and assistants. The final figures for the 11,567-acre tract show 65,898 M bd. ft. of ponderosa pine, 9,432 M bd. ft. of white fir, 18,957 M bd. ft. of Douglas fir, 8,555 M bd. ft. of western larch, and a considerable quantity of small lodgepole pine and western juniper.

Rocky Mountain

Tree Classification. F. P. Keen's tree classification has been found to work well in the ponderosa pine stands of the Black Hills as well as in lodgepole pine, and preliminary tests indicate it may be applied to Engelmann spruce. The system was seized upon by the Station as ideal for classifying growth potentialities of trees for both growth and yield table work and in marking timber for cutting.

In the Black Hills it worked remarkably well for both age and vigor classes. Growth was measured before and after selection cutting by these classes and tested by analysis of variance.

The system works equally well in lodgepole pine and will be used in projected growth and yield studies and in marking timber for cutting. The insect susceptibility question is not very serious in lodgepole pine in Region 2 and reproduction is usually adequate in this species but a method of classification for marking based on growth potentialities has long been needed. A new phase has been the specification of amount of release needed by tree classes. For example, Class A trees will respond if released in but one quadrant but Class C trees should be released in at least three quadrants if left in the residual stand at all.

The result of this work will be slightly lighter cutting, leaving the stand composed of the most vigorous trees. The improvement, genetically, will be great. The rate of growth of the residual stand will be increased, and marking will become more systematized.

Southern

Thinnings: Pines. Bull's slash pine thinning study has been carried to the point of completing alinement charts for the following estimates: (1) number of rings per inch from crown width ratio, crown length ratio, and age at breast height; (2) number of rings per inch from crown width ratio and age at breast height; (3) crown length ratio from crown width ratio and age at breast height; (4) crown width ratio from number of rings per inch and age at breast height.

Of these, the most useful are numbers (2) and (4). From (2), the growth rate and hence the future d.b.h. can be predicted for a given stand to be thinned in a given way, by estimating the increase in crown width that the new spacing will allow. From (4), thinning schedules for producing different constant growth rates can be drawn up, or the results of various series of thinnings not producing constant growth rates can be predicted and tabulated--in either case producing theoretical stand tables as a basis for comparing results with respect to volume, quality, and value. To help in predicting quality, charts for estimating percentage of summerwood and clear length have been prepared.

Chart (1), including crown length ratio as an independent variable, gives somewhat more reliable results (smaller standard error) than chart (2) but is difficult to use in making predictions of growth rate because of the lack of a suitable yardstick for gaging changes in crown length ratio. The yardstick for crown width ratio is of course spacing. Chart (3) is useful as a supplement to charts (2) and (4), in that an estimate of crown length can be added for use in visualizing the appearance of the trees, in checking on the reasonableness of the composite picture, and in estimating quality. The standard errors of estimate for charts (2) and (4), respectively, are 34.5 and 28.6 percents. These seem very high, but it is thought that they are well within the limits required for practical solutions of the problems under consideration. While outright guesses might sometimes come closer to the truth, the charts provide an immediate, unbiased estimate for each and every possible combination of growth rate, crown width, height, and age within a range that includes all values, of each of these four items, likely to be encountered in thinning problems.

With the basic charts at hand, the field of possible uses, indicated briefly above as falling into two main classes, is very wide indeed. Even wider is the field of possible useful ways of working up the infinite number of theoretical thinning schedules that can be made. Work on this phase of the study is the next step. Proof of the accuracy or reliability of such schedules, or of any estimates made from these individual-tree charts, can apparently be obtained only from permanent sample plots--of which the Station now has a fair number, needs many more. Conclusive proof will therefore be a comparatively long time in the making and the results of the present study will presumably have to be offered on a let-the-user-beware basis. The method should give reliable results in the ways in which it is planned to use it--but for the time being there simply will be no proof.

During the past month, data similar to those collected in the slash pine thinning study have been obtained from 36 loblolly and 12 shortleaf pines on 2 permanent sample plots at Urania, at the time of the complete remeasurement of these plots. Similar data have likewise been obtained from 103 red gums on 14 semi-permanent second-growth red

gum yield plots, also completely remeasured this fall. These data will be compared with the slash pine data with the object of determining whether or not the growth rates of other important southern tree species may be estimated from the slash pine charts--either directly or by making either constant or sliding corrections. Preliminary analysis of the data from the 48 loblolly and shortleaf pines shows that the growth rates of these species are estimated almost as closely from the slash pine chart as they could be estimated from a chart specially made from the actual data. This is a very interesting and speculation-provoking result, but needs to be tested with a much larger sample of loblolly and shortleaf pine measurements before any definite conclusions are drawn.

Pruning: Pines. The analysis of tools, methods, and labor requirements for pruning open-grown second-growth longleaf pines was completed, and the results were incorporated in a paper suitable for publication. Alinement charts for estimating pruning time from d.b.h., number of branches cut off, and average basal diameter of branches cut off, were made during the analysis as a means of comparing men, tools, and methods on equivalent bases. The analysis of variance was used to test the significance of differences. In the final report, however, the pruning times, or labor requirements, have been summarized simply by d.b.h. and by the height above ground of the section pruned--in one table for all men and all tools, and in a second table for the fastest men with the fastest tools. The times in the second table range from 16 to 41 percent faster than those in the first table. Great variations in the time to prune were caused by the factors of man and the interaction between tool or method and man. The absolute times that have been summarized are therefore none too reliable, but the relative times for various diameters and sections pruned are considered thoroughly reliable.

In comparison with the preliminary study of pruning times for loblolly pine--made a year ago--longleaf pines require somewhat less time to prune than do loblolly pines of the same diameter. The same types of tools found most suitable for pruning loblolly pine were tested in more detail on the longleaf pines and all gave satisfactory results, with some tools definitely superior to others for all or most of the men that used them. In brief, the best hand saws had short (14-inch), stiff, slightly curved blades and 5 1/2 to 8 relatively long and narrow teeth per inch. The better of only two pole saws tested had the stiffer blade and was the more rigidly mounted on the pole.

Water Requirements. Longleaf and slash pine seedlings were planted by Pessin in similar air-dried soils to which definite amounts of water were added at weekly intervals. These seedlings were growing in sealed containers for one growing season. Five soil-moisture conditions were established: very dry, dry, damp, moist, and wet.

Southern (Continued)

The soils designated as very dry contained moisture amounting to 5 percent of the weight of the air-dry soil; the dry soil contained 10 percent; the damp, 15 percent; the moist, 25 percent; and the wet, about 35 percent. In this last condition the soil was saturated so that free water was standing on the surface. During the growth of the seedlings the soil-moisture content was continually reduced but each week the containers were brought back to their original weight. The distribution of the moisture in the soil of each container was not controlled but since the containers were small (1-quart capacity) the distribution of moisture in the soil did not offer a serious problem.

The results show that the best growth of both slash and longleaf pine seedlings occurred in the "moist" soil. Apparently this soil condition presented optimum conditions for both of these species. In this "moist" soil the needles of both species were longer and more numerous than in any of the other soil-moisture cultures. The dry weights of the plants were also highest in this "moist" soil and the lateral and mycorrhizal roots were also more numerous than in the other cultures. There was a sharp drop in the vigor, dry weight, and general growth in the "very dry" and "wet" conditions, but the survival under both conditions was high for both species, indicating that while growth is best in the "moist" soil, both longleaf and slash pines can endure dry sites as well as wet sites.

Southwestern

The Use of Sodium Arsenite In Timber Stand Improvement. An experiment designed to determine the approximate amount and most efficient method of applying sodium arsenite to standing trees marked for removal in timber stand improvement operations was started in June, 1936, and completed by fall of the same year. The experimental material comprised 300 marked trees in an even-aged group of ponderosa pine and represented a range of 3.7 inches to 13.9 inches in diameter. The average height was 30 feet, volume 3.1 cubic feet and diameter 6.9 inches.

The treatments employed were as follows:

1. Hole bored with 3/4-inch bit 2 1/2 feet above the ground at an angle of 45 degrees with the vertical, directed toward the center of the bole, and to a depth of approximately 5 inches. This provided a storage space sufficient to hold 25 cc of poison solution.

2. Same as No. 1 with an additional hole on the opposite side, giving a total solution capacity equal to 50 cc.

3. Same as No. 2 but with holes on the remaining two sides, giving a solution capacity equal to 100 cc.

Treatments 4, 5, and 6 were identical, respectively, with 1, 2, and 3 except the holes were tangential, thereby keeping the solution in the sapwood and close to the cambium.

Ten trees selected at random from those marked were assigned to each of the six treatments and replicated five times, using a different solution strength for each replication. Poison was applied on June 3 in measured quantities of 25 cc to a hole and the progress followed thereafter by weekly examination until the death rate dropped and remained at zero. By June 29, 56 percent of the trees were dead and by August 17 the total dead had risen to 86 percent at which time the poison appeared to have exerted its complete effect as no additional trees died subsequently.

Table 1a is a summary of dead tree frequency counts on June 29 and table 1b the analysis of variance of the data after the values in the preceding table had been transformed by the relationship

$$\text{Cos } A = (1 - 2p)$$

where p = the proportion dead. This transformation was necessary to overcome the restriction on variation due to very strong and large quantities of poison in some of the treatments.

The information derived thus far can be summarized as follows:

1. The amount of solution injected is much more important than the concentration. In other words, 5 grams of sodium arsenite in 50 cc of solution is much more effective than the same amount of arsenite in 20 cc of solution.

2. Good distribution is essential. Increasing concentration will not offset the disadvantage of poor distribution. The injection of strong localized solution of arsenite commonly leads to only spot killing of the crown.

Table 1a.

Grams sodium arsenite per 100 cc of solution	Incision type						Total
	Central			Tangential			
	1	2	3	4	5	6	
4.05	3	2	8	3	3	7	26
8.10	4	4	8	4	4	8	32
15.60	2	8	9	6	6	8	39
31.28	2	7	7	6	6	9	37
56.80	3	8	9	3	9	8	40
Total	14	29	41	22	28	40	174

Southwestern (Continued)

Table 1b. Analysis of variance.

Source of variations	D. F.	Sum of squares	Mean square	F.	Significant
Wood	1	43.2	43.20	1.611	No
Concentration	4	913.8	228.45	3.282	No
Treatment	2	3899.4	1949.70	28.013	Yes
W x C	4	139.8	34.95	1.991	No
W x T	2	196.2	98.10	1.409	No
C x T	8	1035.6	129.45	1.860	No
W x C x T	8	556.8	69.60		
Total	29	6784.8	233.96		

Table 2a.

Grams sodium arsenite per 100 cc of solution	Incision type						Total
	Central			Tangential			
	1	2	3	4	5	6	
4.05	5	7	9	6	9	8	44
8.10	6	8	10	7	8	9	48
15.60	7	10	10	9	10	10	56
31.28	7	10	10	8	10	9	54
56.80	10	10	10	6	9	10	55
Total	35	45	49	36	46	46	257

Table 2b

Source of variations	D. F.	Sum of squares	Mean square	F.	Significant
Wood	1	97.2	97.20	1.064	No
Concentration	4	2175.0	543.75	5.259	Yes
Treatment	2	2862.6	1431.30	13.842	Yes
W x C	4	553.8	138.45	1.339	No
W x T	2	109.8	54.90	1.883	No
C x T	8	508.4	63.55	1.627	No
W x C x T	8	827.2	103.40		
Total	29	7134.0			

3. The impression derived from earlier work that injections directed into the sapwood are more effective than those directed into the center of the bole did not hold true. This lack of corroboration may, however, be due to the fact that the experiment was centered on trees too young to show any sapwood-heartwood differentiation.

4. The wood-concentration, wood-treatment and concentration-treatment interactions were not significant.

5. The effect of concentration is apparently slower in action than the amount of solution as its significance was not established until the experiment reached completion.

6. While tangential applications of poison did not (at least in small trees) show any increase in number killed, it is, nevertheless, to be preferred in that it appears to destroy more rapidly and renders unpalatable a larger area of cambium to ips.

7. Two 25-cc injections of solution containing a total of 4 grams of sodium arsenite to an injection and applied on opposite sides of a tree is sufficient to kill ponderosa pine 12 inches in diameter or smaller. The applications of poison should be made in small, deep holes to insure satisfactory distribution and consequent diffusion.

Sodium arsenite is extremely poisonous to animals as well as humans. Cases have been reported which indicate that livestock prefer it as a source of salt and with deadly results. Its application to trees on areas open to grazing should be such that it will not be readily accessible. The use of a 1/2-inch bit for making holes should be ample protection from this source of trouble providing the solution is not spilled promiscuously. Additional protection can be obtained if desired by plugging the openings with soil.

REGENERATION

California

Firebreak Planting. The experimental plantations established on the San Dimas Experimental Forest to determine the merits of certain succulent species for establishing a low fire-resistant cover on fire-breaks have been reported previously. At that time high temperatures and drought conditions were the only two critical factors to which the plants had been subjected. Recently, a test of their ability to withstand one of the coldest periods experienced in southern California since 1913 revealed this as one of the most critical factors upon which the success or failure of their establishment depends.

During the 9th of December the temperature dropped to 23° at the Tanbark plot for a period of one hour and remained below freezing for 14 hours. Mesembryanthemum edule was the only species affected by this temperature, its mortality being 100 percent. The reaction of M. edule on the other five plots indicates that 25 degrees is the critical point. The minimum temperature recorded at Plot No. 4 in Bell Canyon was only 25 degrees, yet at this point M. edule was severely damaged, as was evidenced by the flaccid condition of the foliage followed by drying of the tips.

On January 9 the temperature at the Tanbark Climatic Station dropped from 32 degrees at 4:00 p.m. to 20 degrees at 7:00 p.m. and remained at that low point for an hour. Temperatures recorded six inches above the ground were as low as 18 degrees. This drop was sufficient to kill all species but Mesembryanthemum croceum, M. lehmannii and Stomatium agninum. The lowest temperatures recorded were on January 21 and 22 when the thermometer dropped to 11 degrees at the Tanbark plot. At this point, M. croceum, M. lehmannii, Stomatium agninum and Atriplex semibaccata were severely damaged but apparently not killed.

The following table has been prepared showing temperatures at which each species was damaged or killed. (See p. 16.)

These low temperatures have not only affected the exotic succulent species, but a number of the native shrubs also. Rhus laurina and Baccharis viminea appear to have suffered the most, with Salvia mellifera and Eriodictyon trichocalyx showing frost damage.

Whether or not complete killing of the succulents has occurred is not known, but examination of the plots will be continued to determine the extent of the damage and the ability of the plants to re-establish themselves.

California (Continued)

Species	Damaging temperature	Killing temperature
Mesembryanthemum edule	25°	23°
" aequilaterale	25°	23°
" roseum	25°	20°
" croceum	22°	Undetermined
" tenuifolium	25°	20°
" lehmannii	20°	Undetermined
" blandum	22°	18°
Stomatium agnimum	18°	Undetermined
Euphorbia mauritanica	22°	16°
" laro	30°	24°
" tirucallii	30°	24°
" viminale	30°	24°
" antisyphylitica	30°	24°
Atriplex semibaccata	22°	Undetermined

Intermountain

Ponderosa Pine Seed-Fall. One hundred seed traps on the Boise Basin Experimental Forest in central Idaho caught 6,856 ponderosa pine and Douglas fir seeds during the fall of 1936, as contrasted with none in 1935. This is equivalent to an average of 187,280 pine and 86,960 fir seed per acre reaching the ground on the areas sampled. The 1936 seed crop of ponderosa pine was unusually heavy in this locality; that of Douglas fir was medium to light. The 1935 cone crop of both species had been a nearly complete failure.

The pine seed collected in traps was of high quality, averaging 86 percent sound by cutting test. The apparent viability of the fir seed was only 28 percent. Only one trap of the total 100 failed to catch at least one sound pine seed, while 66 of the traps yielded no sound fir seed. This is the result of irregular and groupwise distribution of Douglas fir trees over the area sampled, on which fir comprises about 20 percent of the merchantable volume. The following table shows average numbers per milacre of sound seed reaching the ground under the various stand conditions where the traps were placed.

In general, the data show that in a good seed year it is certainly not lack of seed that is responsible for scarcity of pine reproduction. The large numbers indicated for selective cutting areas are particularly encouraging, as it had formerly been suspected that one of the major reasons for lack of subsequent reproduction was insufficient seed supply. The relatively low average numbers for virgin forest are surprising; also the fact that the 60-year-old stand produced almost as much seed as the virgin stand. The difference

Intermountain (Continued)

between areas represented should not be ascribed wholly to stand age or treatment, however, as they are not strictly comparable in other respects. Direction of slope exposure and general degree of isolation of trees in the stand appear to have a large influence on seed production; these factors could not readily be segregated in the analysis of data because of the placement and limited number of seed traps.

	Number of sound seed per milacre (or number of thousands per acre)			
	PONDEROSA PINE		DOUGLAS FIR	
	Average	Std.Error	Average	Std.Error
Virgin P. Pine type; all exposures	104.7	16.4	3.8	-
Selectively cut stands:				
Economic selection; medium reserve; W. exposure	356.0	62.8	0.7	-
Economic selection; medium reserve; N. exposure	82.1	9.6	92.2	8.4
Silvicultural selection; light reserve; S. exposure	304.6	29.2	0	-
Even-aged second growth; 60 yr.-old; all exposures	100.5	18.4	0	-
All stands	160.5	14.4	24.0	4.4

Many incidental facts of interest are being revealed by the study, such as those relating to time of seed-fall. Pine seed began falling about August 15; collections were made from the traps on September 15 and November 15. Of the total autumn catch of pine seed, 64 percent was obtained by September 15, and 36 percent in the following two months. Of the total fir seed, however, only 39 percent fell by September 15, and 61 percent after that date. Additional seed of both species will continue to fall during the winter and spring, but in view of the habits of the species and the dry weather prevailing last fall, the amount should be relatively small. The difference in apparent soundness of seed obtained on the two dates was insignificant for each species - a result which tends to refute the prevalent idea that "the best seed falls out first."

Lake States

Seed Extraction Tests. Experimental tests on the seed extracted in the new kilns designed by the Forest Products Laboratory are nearing completion. The results of the tests on the jack pine extracted at Cass Lake indicate that extraction temperatures of greater than 170° F. are harmful.

Lake States (Continued)

Fundamental Studies. Tests with the new drought machine which is large enough to contain 200 plants have already justified its construction. The possibility of handling such a large number of plants at one time enables the results to be obtained in such form that they are subject to rigid statistical analysis. A series of experiments are now being started in an attempt to develop a hardening treatment by controlled watering which will increase drought resistance. Preliminary tests already indicate that this has considerable possibilities.

Southern

Seed Source Study: Pines. The data concerning the origin of the 42 lots of seed received by the Station last spring, in connection with the study of geographic sources of southern pine seed, were compiled in a report to each cooperator who contributed seed or undertook to sow some of the 393 samples distributed throughout the southern pine region. Fourteen nurseries, in addition to the Station's experimental nursery, sowed samples of from one to four species, and to each of these cooperating nurseries a suggested plot lay-out was supplied as a guide in laying out experimental plantations of the stock from various origins. Late sowing in some of the nurseries resulted in poor stands of seedlings and very small stock, and at other nurseries it has been difficult to arrange for planting on an adequate scale, but it is hoped that sufficient cooperative plantations will be established to test each seed lot in several parts of the region. The Station's plantations in connection with this study were all put in on the Palustris Experimental Forest.

During the month the Station set up 22 service germination tests, of 1,000 seeds each, for the nurseries in Region 8, using seed drawn essentially by the sampling method devised by Chapman.

Nursery Studies. The final results of the tree-percentage study in 1936 confirmed the 1935 findings. The past three years' work indicates that it may be possible to increase germination and reduce the losses following germination (thereby increasing final tree percentage) of longleaf, slash, and shortleaf pine to a slight extent by (a) the use of burlap mulch, (b) sowing early, and (c) watering immediately after sowing and during germination. However, because nursery germination is practically as good as corresponding laboratory tests, and because the chief losses occur before sowing rather than after germination, the real solution of the problem of low tree percentages would seem to lie in developing satisfactory methods of handling and storing seed prior to sowing. Emphasis is being placed on this phase of forestation at the present time.

The green-manure study has been concluded and the results of the 1935 and 1936 work showed that for Stuart Nursery conditions

Southern (Continued)

velvetbeans were preferable as a green-manure crop to cowpeas, Crotolaria, and Sesbania. It should, however, be borne in mind that with the use of fertilizer two crops of cowpeas can be produced a season, whereas only one crop of velvetbeans can be grown. Both species should, therefore, be seriously considered in deciding on the final soil-management and crop-rotation program.

MENSURATION

Appalachian

Number of Borings Needed For Growth-Rate Determination. During the remeasurement of a group of permanent sample plots, a check was made to determine the number of increment borings necessary to ascertain the mean rate of radial growth during the past five years. In this work two borings were made on each of 42 dominant and codominant 8-inch longleaf pine trees. The directions of the borings were determined randomly. For each boring, growth during the past five years was measured to hundredths of inches. In order to check whether the number of borings necessary to obtain a mean value of certain accuracy was correlated with rate of growth of the trees bored, the data were assembled by 0.1-inch-rate-of-growth classes and analyzed. The results of the analysis given in the following table indicate that the number of borings necessary for determination of the rate of growth of any one tree is not appreciably influenced by the rate of growth of the tree.

If the mean value for an 8-inch longleaf pine is desired, 31 borings have to be taken if 3 percent standard error is desired, or five borings if a standard error of 8 percent is satisfactory.

GROWTH CLASS-INS. RADIAL GROWTH IN 5 YEARS

	.10-.19	.20-.29	.30-.39	.40-.49	All Classes
Source of Variation	Mean Square				
Between trees	.00112	.00183	.00182	.00206	.01683
Within trees	.00287	.00324	.00296	.00350	.00312
Total	.00209	.00257	.00241	.002827	.00910
No. trees	5	12	17	8	42

However, when the determination of the number of borings necessary to get a mean value for a diameter class is made, it is evident that the wider the range of growth rate within the diameter class, the more borings will be necessary. From the above table it can be seen

Appalachian (Continued)

that if two borings are taken per tree, approximately 50 8-inch trees have to be bored to get a mean value with a standard error of 3 percent, or 16 trees to get a mean 8 percent.

Rocky Mountain

Volume Tables. New volume tables for lodgepole pine and for Black Hills ponderosa pine made from basic data selected randomly over the range of each, were completed this month. One phase of the work was to turn out a couple of new board-foot cruising tables. Although the new Black Hills table varies from the one previously used by some 12 percent the new lodgepole table checks the old one (made in 1915!) almost exactly. It was also found that the correlation of height with board foot volume of lodgepole pine, in merchantable sized trees, is very slight. In fact, by using diameter alone the volume of timber on any fairly large area can be determined with a loss of less than 5 percent accuracy. As a result, a new table has been drawn up which has, in addition to volumes by diameter and number of logs, volumes by diameter alone. A check of this new heightless volume table with a mass of both ancient and new tree measurements shows an aggregate deviation of less than 1.5 percent. The result will be faster, cheaper cruising except on small areas where the "tree measurement" system is used.

The form of Black Hills ponderosa pine, however, prevents any such simplified method, the volume being correlated with height to such an extent that a loss of 35 percent in accuracy would result if diameter alone were used in cruising.

PROTECTION

Fire

Appalachian

Fire Control and Prevention. Development of a haze meter for use in flat country has progressed sufficiently so that Byram has prepared specifications for a new model. It will be built in time to permit tests during the coming spring fire season. Instead of using ridges lying at different distances from the lookout as targets, it is believed that the shaded sides of clumps of trees at known distances from the observer can be used. If so, a change in the photometric part of the meter is required, but the fundamental principle will remain the same.

California

Wind Studies. During the 1936 field season wind studies were made to determine the variation of wind velocity with height in a forest stand. Before measurements were started in a forest stand a series of readings was first taken on level ground with moderately light wind. The plot where this study was made was approximately one-half mile wide and one mile long with a pine tree 120 feet in height located near the center. At the top of this tree was mounted a standard 3-cup anemometer. Due west 100 feet a 45-foot pole was placed with provisions made for a recording vane anemometer to be mounted at 10-foot intervals, starting at 40 feet above the ground level. A third anemometer of the vane type was placed near the pole at thirty inches above the ground level. The 3-cup and the vane anemometer on the pole were connected to a continuous recorder. A series of records was taken with the anemometer on the pole at various heights. The period of the continuous readings were all above 15 minutes in order to compensate for the horizontal spacing of the anemometers and to smooth out the effect of gusts on velocity. The object of obtaining data on the plot was to provide a comparison with data taken in a forest stand under similar wind velocity conditions.

After the work was completed on the plot similar records were made in a moderately dense second-growth ponderosa pine stand. In this study two 3-cup anemometers were used. One was located approximately 15 feet above the average height of the stand. The second 3-cup anemometer was mounted at a height of 142 feet on a nearby tree, or approximately 75 feet above the stand. The results of this study show that the wind velocity within the stand is almost the same. It appears that the whole mass of air from the tops of the trees to the opening between the crown and the soil has a uniform motion. The slowing up of the wind velocity evidently occurs in the upper portion of the canopy. Below the crown the wind again decreases in velocity until it reaches zero at the ground surface.

To determine if there was any correlation between the wind movement at Pilgrim Creek Nursery at Black Fox Lookout on the Shasta National Forest, continuous records were made of the wind velocity at the two points over a period of two months. The difference in elevation at the two points is 2610 feet.

Preliminary analyses indicate that maximum and minimum velocities during a 24-hour period occur at the same time. The ratio of the wind velocities at the two points remains practically a constant throughout the 24-hour period.

Northern Rocky Mountain

Coding and Redesigning Regional Fire Report. Annually, since 1930, the Experiment Station has been directly or technically responsible for coding the Region One fire reports, Form 929, so that these data could be (1) immediately punch-carded and tabulated as a basis for filling out most of the Fire Sheets A to M, and (2) made ready for research analysis. The Region provides three men and three clerks to code the data in form for punch carding, while the Station gives general supervision, prepares the descriptions of the sorts and tabulations desired, and adds the weather data that have a bearing on each fire.

Two new types of information were coded this year: (1) The fuel type rating such as high-high, high-low, medium-medium, and (2) the fire danger rating first of behavior and second of organization strength. The fuel type rating for the spot of origin of the fire is essential information if these data are to be sorted and analyzed to determine actual rates of spread and resistances to control encountered by the first attackers. The actual rate of spread will be expected to check with the mapped rate only on average bad days, of course, because that was the basis for classification by the mappers. The selection of these Class 5 days will be possible as a result of the coded data added by the Station, using the records of the nearest inflammability station within 30 miles of the fire.

It is obvious that both fuel type and fire danger data are essential to the rating of efficiency, to the determination of specific weaknesses, and to the discovery of most common possibilities of improving fire control. These data have not been provided in form for best use on the past fire reports. They are very likely to be rated as essential after fire control planning and fire danger measurement are extended and developed in other Regions.

Several other changes and improvements in the Form 929 can be made (1) to meet new ideas of essential data; (2) to record the data on the 929 in form for easy and accurate coding; and (3) to present the data in class intervals suitable for statistical analysis so that dependable conclusions can be assured. The likelihood of revision of the Form 929 was granted at the February, 1936, fire meeting in Spokane. The Region Eight bulky instructions for coding the data emphasize the need. If someone with statistical training should try to determine correlation between factors or the mean square in error for discovery time by Forests, the need for revising the Form 929 would be further stressed. Even so, it probably is desirable to continue to use the present form through 1940.

In the meantime there is a rapidly increasing need for assembling information so that the new form, to be put into use in 1941, will be as efficient as possible. Design of the Form 929 is as basic to good fire research as design of field plots is to good silvics or silviculture.

The use of this form is so widespread throughout the country that its proper design deserves critical attention by both research and administration. The job has so many ramifications that if work were commenced soon a satisfactory product might be ready for use in 1941.

Southern

Chemical Control. T. R. Truax of the Forest Products Laboratory, accompanied by two assistants and with the help of the Station's fire-project men, initiated some chemical fire-control tests on the Harrison Experimental Forest during January. Six chemicals that showed promise in earlier laboratory tests were studied intensively in experimental burns in grass cover of the longleaf pine type. The chemicals were tested in two uses: (1) as a pretreatment to reduce combustibility of the grass fuel in burning firebreaks and in backfiring, and (2) as a direct application to extinguish going fires. Accurate records were kept of the amount of solution applied in each test fire and of the weather conditions prevailing during the test period. Preliminary results are encouraging, especially for mono-ammonium-phosphate. The effectiveness of each chemical is based on using water as a standard.

Effect of Fire on Soil. Additional evidence that a very heavy rough may be removed by fire without destroying soil organic matter within the soil (as contrasted with the litter and duff) was obtained. The area studied had been protected for more than 30 years until 1935 when a light fire occurred. Tests showed that the total nitrogen in the top half inch of soil from an area within the fire was not significantly different from that from an adjoining unburned area.

Entomology

Central States

Locust Borer. Hall and Secrest have devoted practically the whole month of January to statistical work on locust borer data from the Carnes Experimental Area. A three-year summary is being prepared on the performance of various sample plots which have received treatments of various sorts in an attempt to increase rate of growth or to improve form. The mulched, thinned, and fertilized plots have all showed a significant response to such treatment. A summary of the pruned plots indicates a significantly higher borer emergence for the past season than do the unpruned checks. This is probably due to added borer attack in the pruned trees by creating more favorable conditions for oviposition through the breaking and scarring of the bark in the pruning operations.

Pathology

Allegheny

Nursery Disease Project. Mr. Kaplan, who was assigned to the project last year, resigned on October 15 and returned to Cornell University to continue his graduate work. Dr. Wean, who was stationed at the Parsons Nursery during the summer of 1936, succeeded Mr. Kaplan on the project November 1. Field work was discontinued about November 15 on account of winter conditions.

A conference on the future program for the project was held at the Washington Office on November 16-18. The work of the past field season was discussed and plans were drawn up for the publication of the results.

The New Jersey State Nursery at Washington Crossing put in a fall sowing with red pine and white pine. As a consequence of the fall sowing program it became necessary to install test plots, using a few of the best treatments. The nursery set aside a strip of land for experimental purposes that can be used permanently by our office without disturbance. The treatments listed this fall were surface applications with formaldehyde, sulphuric acid, acetic acid, and aluminum sulphate, and a deep soil treatment with superphosphate.

Treatment recommendations were sent to the CCC Nursery at Newfoundland, New Jersey, for their fall sowing. The only chemical agent prescribed was a surface application of sulfuric acid at the rate of 1/8 ounce per square foot.

The stock culture collection of nursery disease fungi was augmented by a large number of new cultures from the work of the past field season.

The seedlings from a large number of the 1936 treatment test plots were carefully dug and preserved in a formaldehyde solution. An analysis is under way of the root systems in order to determine the effects of certain chemical agents on root development and root rots.

Numerous general inquiries were received and answered. Many of them pertained to the plane-tree disease. Three field inspection trips were made on the plane-tree project. Observations to date seem to indicate that the disease is spreading very rapidly throughout Lower Merion township, Pennsylvania.

Biology

California

Cooperative Quail Study on Foothill Ranges. What are the practical management facts in the life cycle of valley quail in the San Joaquin foothills? What, for example, is the effect on quail population of such influences as livestock grazing, cover, food, water, and predators?

A cooperative experiment has just been undertaken to seek the answers to these and other questions on quail management. Ben Glading, naturalist, has started field studies. Technical planning and supervision are handled jointly by Dr. Tracy I. Storer, University of California, and E. E. Horn, Biological Survey. The Madera County Sportsmen's Association is also interested. The Station supplies administrative supervision, the facilities of the San Joaquin Experimental Range, and coordinate with the Region on findings concerning range management.

A quail census of the San Joaquin Experimental Range, just completed, indicates a population of approximately 2,500 birds -- averaging slightly less than 1-1/2 acres per quail. In following their daily routine Glading is employing a bright-painted feather on selected birds, a unique aid to identification developed by Dr. Storer and associates in the Zoology Division of the University.

Recent Rodent Rations. On September 26, 1936 a cache of five white-footed mice was found in a wooden tool box at the Burgess Spring Experimental Range (Black's Mountain Branch). The cache was found under a nest consisting of bits of paper and a large quantity of woolly floss.

Analysis (of the cache) revealed that mice are evidently very particular in their selection of winter food. Grass seed (Festuca, Sitanion, and other unidentified kinds) headed the list with a percent of nearly 88. The only other seed in sufficient quantities to be weighed was that of Ceanothus prostratus, and Pinus ponderosa and P. jeffreyi. The computed ration, of interest to foresters and biologists, follows:

Food	Grams	Percent
Grass seed	120.88	87.8
Pinus ponderosa and P.jeffreyi	11.12	8.1
Ceanothus prostratus	5.64	4.1
Total	137.64	100.0

Southern

Analysis is well under way of the second-year yields from a test of the economic feasibility of turpentining the living bars between worked-out faces on trees which are usually considered worked out. Results indicate that the yields from faces of this type may be expected to hold up well; higher-yielding trees showed a greater increase than low yielders. Two-inch bark bars on each side of the face were about as good as 4-inch or wider bars so far as the yield was concerned, but in ordinary practice a bar under 4 inches is too liable to be chipped through to be practicable.

Preliminary analyses were made of the growth in the turpentine face section of the tree following turpentining. In confirmation of the results previously reported by Harper, an average growth reduction of about 25 percent was found for the section of the tree above the face. The analysis showed a wide variation in the response of trees to turpentining, and that a large number of data will be needed to satisfactorily ascribe this variation to measurable tree characteristics and to variation in methods of turpentining. Although not providing even an approximate solution, the analysis and preliminary observations have added considerably to an understanding of the problem and the methods of its solution. It was shown that despite a reduction in the basal area, or volume growth, the perimeter (which makes future faces possible) in the turpentine portion of the stem grew more rapidly than if the tree had not been turpentined. This is due to the healing which takes place at the sides of the faces. The diameter at which to start chipping in order to get the maximum naval stores lease of life must take this fact into account.

FOREST ECONOMICS

LAND USE

Pacific Northwest

New Public Domain. The course of tax forfeitures of forest properties was examined in Thurston, Snohomish, and Whatcom Counties in Washington. Moratoria on tax foreclosures, which prevented earlier examination, seem on the one hand to have affected the course of abandonment for unpaid taxes very little, and on the other hand to have delayed terminating tax delinquency of abandoned lands and placing such lands under management and in stable ownership. Acquisitions of county and other forest lands by the State of Washington since 1932 were listed and mapped for counties selected for intensive study.

Preliminary studies of principles underlying a sound rural zoning law for Oregon, a possible facility for discouraging unwise settlement of lands suited primarily for forest purposes, placed the Station in position to comply with the request of the State Planning Board and to aid in the drafting of a rural land use districting bill in cooperation with the State Agricultural Experiment Station and the Resettlement Administration. Because of the desire expressed by the agricultural group to confer further with farm, livestock, and other agencies, this bill may not be introduced at the legislative assembly now in session.

Land Classification. Cooperation continued with the Washington Agricultural Experiment Station and the Resettlement Administration in connection with land economic surveys. The Curry County report, prepared by the latter agency, came in for special analysis and treatment by Director Munger and by the section because this is the first report of this nature prepared for Oregon.

Taxation. Through membership of the Director on the special tax committee appointed by Governor Charles Martin of Oregon, the Station aided this month in drafting measures aimed to improve tax foreclosure proceedings; provide for State acquisition, classification and disposal of tax-forfeited lands including liquidation of local tax equities therein; centralize all title and related records of State lands in one State office.

Planning Activities. Wilson, as chairman of the Land Resources Division of the Regional Planning Commission, participated in preparing and presenting the regional forest program to the commission in Seattle. Also, he spoke before the Oregon Planning Conference on "Major Land Use Conflicts", and aided in the final revision of the Willamette Valley Report of the Oregon State Planning Commission.

Southern

Drainage and Ad Valorem Tax Study: Mississippi. A study of the problem of forest land taxation, with particular reference to the legal aspects and incidence of levee and drainage district taxes on forest land in the hardwood area of the Yazoo Delta in Mississippi was started by Craig.

The counties selected for study are from north to south: Tunica, Coahoma, Quitman, Washington, and Issaquena. Within the selected counties, those townships will be studied which, according to the land-roll classification and according to the aerial survey by the U. S. Army Engineers, are 50 percent or more in forest. Within the selected townships, those individual properties will be studied which are primarily classified as 50 percent or more in "uncultivatable" and "timbered" land. Those properties which are classified primarily as "cultivatable" land will be excluded from study. As indicated in the preceding paragraph, the purpose of the study is to determine the actual tax burden on forest land with special reference to the incidence of drainage and levee taxes thereon. So far as is possible under the limitation of time and funds, the forest land will be classified as to type and condition of forest growth, and the tax burden allocated and determined for each of the various types and conditions recognized. The tax burden itself will be broken down into the several components of the total tax charge; namely, the state, county, school, road, levee, and drainage district levies.

It is recognized that the high taxes levied for drainage and levee purposes are one of the major obstacles to private forestry operations in the hardwood area of the Yazoo Delta, and likewise are one of the most fruitful causes of chronic tax delinquency of forest land therein. Hence a study of these particular items in relation to the other ad valorem taxes for general governmental purposes will do much to shed light on a situation which is recognized by many authorities as one requiring early attention.

Arrangements for cooperative assistance have been made with the State Planning Commission of Mississippi, the Land Planning Specialist of the Land Utilization Division of the Resettlement Administration for Mississippi, the State Tax Commission, the Federal Land Bank in New Orleans, the Delta Chamber of Commerce, Stoneville, Mississippi, the State Forester, the Supervisor of the National Forests in Mississippi, and others. Field work on this project will start February 1 and should be completed on or before June 30, 1937.

LOGGING

Southern

Pulpwood from Tops of Sawtimber Trees. The extremely rapid development of the pulp and paper industry in the South during the past few years has increased the demand for pulpwood tremendously. From information available in regard to the establishment of new pulp plants in the South, it is apparent that within the next two years many more timberland owners will have a market for pulpwood. A considerable part of this pulpwood will come from tops of sawtimber trees, which in the past have been left in the woods as waste.

Reynolds in his selective logging study in second-growth shortleaf and loblolly pine at Crossett, Arkansas, cut the tops of sawtimber trees into pulpwood. He found that the volume of rough wood which can profitably be cut into pulpwood increased from about 7 cubic feet per top for 12-inch trees (d.b.h.) to approximately 9 cubic feet for 20-inch trees. For sizes from 20 inches upward, the volume per top declined rapidly, due to the fact that the tops of the larger trees bear such large limbs, making profitable pulpwood production impossible. Twenty-five inch trees contained approximately 3 cubic feet of available material and 30-inch trees contained approximately 2 cubic feet per top.

Considering all sawtimber trees of all sizes removed in Reynolds' selective cutting, which removed approximately 50 percent of the merchantable volume in a typical second growth natural stand, the average volume of pulpwood per top amounted to 7.99 cubic feet. The ratio of pulpwood to saw log material was .3 of a standard cord of pulpwood to each 1,000 board feet of saw logs cut. In this case approximately 3,000 board feet of saw logs were cut per acre and slightly less than one cord of pulpwood per acre was also cut from tops of the felled saw timber trees.

The total merchantable volume of pulpwood in the tops made up 14.4 percent of the total merchantable volume of all trees. For 12-inch trees pulpwood in tops made up 30 percent of the total merchantable volume, for 20-inch trees, 12 percent, and for 30-inch trees, approximately 2 percent.

In addition to pulpwood from tops, an average volume of 1.3 cords per acre was cut from crooked and defective trees, which contained no saw logs and which would not pay for further growth.

Pacific Northwest

Selective Timber Management in Ponderosa Pine. The major effort during the past month was to work out the results of Payne's log grade cruise of the 10,000-acre experimental cutting area on which the Hines Company are now operating. On this area the timber has been marked in accordance with the light selective cutting system tentatively adopted last summer to test the conclusions reached in the Hines study. Payne's cruise, undertaken subsequent to the marking, gives an actual record of the volume and character of the timber marked and the timber to be left.

The results of this cruise show that 39.7 percent of the total volume had been marked for removal, whereas the predicted volume removal as based on the study analysis was 40.8 percent. The average "tree value" of the trees marked for removal, based on detailed log grading of about 2,000 sample trees, is $4.97 per M, which is almost precisely the same as that predicted in the Hines study analysis for the same percentage of removal. The average value of all trees more than 12 inches in diameter is $2.04 as compared with a predicted value of $1.95. The average value of a hypothetical cut based on standard 85 percent Forest Service marking is $2.40 according to Payne's log grade cruise and $2.65 according to the original study results. It should be noted that Payne's cruise applied only to the 10,000-acre experimental area, whereas the predicted study results apply to the entire working circle of several hundred thousand acres, which naturally leaves considerable chance for differences on account of possible local variation in the character of stand. The agreement here found between predicted and actual results is, therefore, surprisingly good.

FOREST SURVEY

Northern Rocky Mountain.

Progress of Check Cruise Staff. During the past month, a comparison was made of estimates by the Forest Survey cruisers and those of check cruisers. Check cruise field work started in May under G. M. DeJarnette; in July, P. N. Pratt took over this work. Cruisers were checked throughout the season. In August, J. W. Girard, Assistant Director of the Forest Survey, checked the field work of the entire crew.

Checks indicated cruising to be relatively satisfactory. The survey cruisers were 1.6% low for white pine, 3.8% high for ponderosa pine, 9.4% low for western larch, 9.5% high for Douglas fir, 3.9% low for white fir, 9.7% high for hemlock, 15.9% low for red cedar, 22.3% low for Engelmann spruce, 21% low for lodgepole pine, and 2.2% low on the total for all species. Since spruce and lodgepole were 1.8% of the total volume found, in the checks, their being out of line is not unreasonable.

Northern Rocky Mountain (Continued)

The correction factors needed to bring the many public and private cruises to the standards of the Forest Survey were also completed this past month. The correction factors increase the volumes of most of the cruises from 10% to 15% for the major species due mostly to more intensive cruise specifications of the Survey. The minor species show a larger increase for most of the cruises. In some areas the survey cruise lowered private cruises. This was due, mainly, to fire, disease, or insect damage occurring since the estimate was made.

For the past two weeks the check cruise staff of three men has been compiling the merchantable timber volumes for Pend Oreille County, Washington. This work is about 60% completed.

Inventory Phase. Inventory statistics for Pend Oreille County, Washington, reveal that but 20 percent, or 156,404 of the 782,709 acres, bear stands of merchantable quality. Of the remainder, 501,320 acres are in immature stands; 62,773 acres are restocking after recent cutting or fire; and 62,212 acres are deforested as the result of old fires or cutting. However, 19,928 acres of this merchantable timber land have been selectively logged in the past, and 3,463 more acres are in the non-commercial zone, thus reducing the available uncut merchantable stands to 133,013 acres or approximately 17 percent of the timber land total. Subalpine and rocky areas of 67,879 acres are not included.

Of the first mentioned 156,404 acres merchantable timber land, approximately half or 78,079 acres are privately owned, and 57,618 acres are in National Forest ownership, the balance being split among State, County, Indian, and Public Domain holdings.

Immature stands have been classified into three general groups, well, medium, or poor, according to the density of stocking. These degrees of stocking offer a practical index of the relative stands of timber land. Approximately 74 percent of the young stand area is well stocked; 20 percent medium stocked; and 6 percent poorly stocked.

Southern

Pulpwood Yields. Recent pulp mill developments in the South have raised the question of the probable effect that pulpwood cuttings will have on the continued productiveness of areas of second-growth pine. An analysis of the principal loblolly and shortleaf pine types in Texas Survey Unit No. 1, which is tributary to the Champion Fibre Company's new pulp mill at Houston, indicates that, in areas of sawlog size second growth in these types, if all pines 5 inches or more in D.B.H. were to be cut for pulpwood or sawlogs, the increment on the remaining small pine trees during the next 20 years would average approximately 1/2 cord per acre annually. Such cutting is not to be

recommended because 1/2 cord per acre annually is only from 1/3 to 1/4 of the full possibilities of the average site, and because deterioration of the stands would eventually result. The assumption of such cutting, however, gives a reasonable indication of what may be expected to occur on those areas so cut.

The analysis, which is summarized in the following tables, is based on the use of one of two cutting plans, and on the application of growth and mortality rates of these particular stands.

PLAN NO. 1

Assumed that all pines 5.0 inches or more in D.B.H. are cut for pulpwood, and a second cut is made either ten or twenty years later.

Forest type	First cut Pine only	Second cut Pine only	
		After 10 yrs.	After 20 yrs.
	Cords per acre		
Loblolly pine	15.6	3.6	10.1
Loblolly-hardwood	7.4	3.4	10.2
Shortleaf-loblolly-hardwood	12.3	4.3	13.0

PLAN NO. 2

Assumed that all pines 5.0 to 12.9 inches in D.B.H. are cut for pulpwood and all pines and hardwoods 13.0 inches and over are cut into sawlogs, and a second cut is made either 10 or 20 years hence.

Forest type	First cut			Second cut					
				After 10 years			After 20 years		
	Cords	Bd.ft.		Cords	Bd.ft.		Cords	Bd.ft.	
	Pine	Pine	Hdwd.	Pine	Pine	Hdwd.	Pine	Pine	Hdwd.
	Per acre								
Loblolly pine	9.4	1760	201	3.6	-	50	8.5	360	242
Loblolly-hardwood	4.6	787	1240	3.4	-	250	9.0	270	668
Shortleaf-loblolly-hdwd.	8.7	917	359	4.3	-	50	11.3	360	292

An estimate of the probable sale value of the stumpage can be obtained by figuring 50¢ per cord for pulpwood and $3.00 per M for sawtimber.

Central States

Proposed Missouri Survey. S. D. Anderson of the Regional Office in Milwaukee visited the Station on January 29 to discuss methods of conducting the forest survey in five Missouri counties: Morgan, Taney, Ozark, Reynolds, and Carter. This project, directed by the Forest Service, is proposed as a W. P. A. project sponsored by the University of Missouri.

FOREST INFLUENCES

Appalachian

Coweeta Experimental Forest. A detailed economic and social history of the Coweeta Experimental Forest has recently been compiled, partly from the files of the Nantahala National Forest and partly from interviews with men who had lived on the area in by-gone days. One of these men, sound in mind at ninety-one years, settled on the area with his parents in 1852. Grazing of cattle, horses, sheep, and mules was the most important use of the land, and semi-annual burning was carried on to improve pasturage. This practice, handed down from the Indians, was continued until 1902. Agricultural activities were confined to the bottom lands where the early settlers raised just enough produce for their own consumption.

The Coweeta Forest tract was purchased in 1921 by the Forest Service under terms reserving timber rights for the seller. From 1919 to 1923 the area was intensively logged.

Under Forest Service administration, there were no fires and no occupancy, so the forest cover grew and developed under natural conditions until at present there is a fine young growth of valuable hardwoods, especially yellow poplar. In 1933 this tract was selected by the Appalachian Station for intensive study of forest influences.

The early history of Coweeta illustrates for the mountainous back regions of the Appalachians, the economic and social conditions of those rugged settlers whose land use practices have had so much to do with present mountain forest conditions and with the behavior of the mountain streams.

Ground Water Studies. Closely associated with the study of forest influences on stream discharge is the investigation of ground water phenomena. Wells have been dug on the Coweeta Experimental Forest for the purpose of observing the effect of the vegetative and forest cover on ground water movements, and learning to what extent these movements are reflected on stream discharge. There are two groups of wells; one located across the valley floor and another on the upper slope of an interstream ridge, representing headwater conditions of

Appalachian (Continued)

the minor tributaries. The first group consists of sixteen wells arranged in two parallel lines 445 feet apart. Of this number, three are equipped with automatic, continuous water stage recorders, while the water surface in the remaining thirteen wells is read at least once a day. To supplement these data, a continuous record of the elevation of the two strems in the valley is also maintained. The wells in this group have been in operation since October, 1935, and have produced valuable information concerning the fluctuations of the surface of ground water. The second group, in the forested area, consists of nine wells spaced in three parallel lines running across the watershed. The construction of this group is not completed. A knowledge of ground water will furnish a better basis for evaluating the infiltration rate of the soil as influenced by different kinds of land use. Since stream discharge depends on subsurface water during periods of low flow, the ground water studies will add to the knowledge of stream control methods.

Central States

Moisture Penetration in Field and Forest Soils. Late in January, after the termination of the prolonged heavy rains responsible for the severe flood in the Ohio Valley, Auten made a field trip into the hills of southern Ohio to observe the relative penetration of moisture in open fields and in forest covered soils. The greater penetration of rain in the latter was very obvious. The forest covered soils were saturated with water to a depth of two feet or more, whereas on the slopes of many abandoned fields the soils were much more dry and compact. A report is being prepared.

Pacific Northwest

Flood Survey Overtures. This Station got into action under the new Flood Survey program with some correspondence and interviews with the War Department officials and with attendance at the first public hearing, at which the Department of Agriculture has collaborated with the War Department, namely, at Yakima for the Yakima River Project. Mr. H. J. Andrews represented the Director at this hearing.

Rocky Mountain

Surface Run-off as an Important Source of Streamflow. It is highly probable on the eastern slope of the Rockies and in other regions throughout the West that certain watersheds should be managed not to prevent but to encourage controlled surface run-off. Much research must follow before concrete data can be obtained to verify this statement but hypothetical possibilities on the important South Platte River watershed in Colorado are exceedingly intriguing.

Rocky Mountain (Continued)

Controlled surface run-off should not be advocated unless the watershed in question receives a considerable portion of its precipitation or recharge as summer rain or unless adequate storage facilities are available to retain the surface run-off. On the upper South Platte River watershed summer rains supply approximately 80 percent of the average annual precipitation at elevations between 6,000 and 10,000 feet. These summer rains are for the most part convection storms that strike with considerable intensity for a short period of time and then pass, leaving a clear sky with normal summer temperatures. Such a combination of factors make it highly improbable that a significant portion of the precipitation from these summer storms ever reaches the ground water to appear later as springs to sustain streamflow. For the most part the rainfall merely soaks the surface soil and then as the storm passes the stage is set for rapid evaporation and the moisture held in the soil and on the vegetation is lost to the atmosphere. To increase streamflow at these lower altitudes, therefore, the best solution may be to increase the surface run-off.

Based on usable but rather inadequate weather records the South Platte River watershed above 6,000 feet elevation receives from precipitation an average of approximately 1,870,000 acre feet of water each year. The average annual discharge as streamflow is only 297,073 acre feet or approximately 16 percent of the recharge. (The small use of water for high altitude irrigation may safely be ignored in this discussion.) Of the total recharge of the watershed in the neighborhood of 1,300,000 acre feet are received at elevations below 10,000 feet, approximately 80% falling as rain. If in order to counteract the high evaporation rates from the soil and vegetation following summer storms, watershed management practices were perfected which would increase surface run-off one-half inch per year, more than 50,000 additional acre feet of water would reach the streams between altitudes of 6,000 and 10,000 feet. This additional one-half inch of surface run-off would be only slightly more than three percent of the average annual precipitation or on a basis of 10 rain storms per year of 0.25 inches and more (actual average per year for last 15 years is 11 to 15 storms of 0.25 inch and more) the surface run-off would need be increased an average of only 0.05 inches per storm. After this additional 50,000 acre feet reached the streams it is estimated that approximately 20 percent would be lost by evaporation, transpiration and infiltration, leaving 40,000 acre feet available for irrigation and domestic consumption during the summer season when it is most needed in the highly cultivated lowlands and the city of Denver which depend upon the present inadequate supply in the South Platte River.

Obviously, management practices designed to increase surface run-off must not induce or accelerate erosion because the benefits derived from the increased flow would be lost if streams and improvements were choked with silt and debris. Nor, of course, should run-off be increased to the point where floods occur but such a possibility is

exceedingly remote on the upper South Platte drainage because management which will prevent erosion has sufficient safety factors to control floods insofar as natural methods are feasible.

Only 28 percent of the area of the South Platte River watershed lies above 10,000 feet and here a different type of watershed management appears to be desirable. At these higher elevations nearly 50 percent of the annual precipitation falls as snow and the main run-off season is about six weeks during the spring melting season. At the time the snow is melting water is reaching the soil in quantities sufficient to reach and recharge the ground water. In contrast to the great annual evaporation possible following summer rains at the lower altitudes the annual evaporation at the higher altitudes is at a minimum because the main run-off is in early spring and free water enters deep into the soil in large quantities to appear later as springs to sustain streamflow during drought periods. Therefore, on a hypothetical basis, it appears that 72 percent of the South Platte River watershed (that below 10,000 feet in elevation) should be managed so as to encourage controlled surface run-off, whereas the remaining lands (at higher elevation in the snow-fall belt) should be managed to secure a minimum of surface run-off.

One of the first problems to be answered in determining the feasibility of such a plan of management is to find out whether or not and how much water received from summer rains at the lower altitudes reaches the ground-water level. As an approach to solving this problem a battery of 18 infiltration tanks was recently installed. Nine of these tanks are 18 inches and nine are 36 inches in depth. Each tank has a surface area of 4.36 square feet and is on a 17.5 percent slope. Surface and sub-surface run-off from each tank will be collected separately in cans placed in a pit below the tanks. The tanks are filled with a homogenous soil mass and the surface will remain barren during the standardization period. Later, various plant species will be grown in the tanks and total surface and sub-surface flow from each tank determined. The flow from the tanks at different depths and from the surface is expected to be a valuable guide and indication as to the kinds and types of lesser vegetation which will provide the greatest usable water yields. Complete watershed units subjected to various range and forest management practices will be established after results from the small-scale experiments have pointed the way.

Southwestern

Water Yield Studies. From measurements made at the Forest Influences Station at Parker Creek the prediction can be made with reasonable assurance that Roosevelt Reservoir may fill late this winter or spring. Precipitation at Parker Creek for December and January has been far above the average recorded during the past 4 years, much of it accumulating as snow at elevations of 5,000 to 6,000 feet. Our installations show, through percolation water yield at considerable depths, that the ground mantle of drained slopes is saturated. This means that future rains or the melting of accumulated snow will cause protracted high stream flows and a large water yield. Roosevelt Dam, completed in 1910 has filled twice, first in 1915 and again 1920. It has been almost empty several times since 1920. At present the chances for refilling by spring are better than at any time since 1920.

FOREST PRODUCTS

California

Logging and Milling Studies. A call from the Pacific Northwest Station for all available information on power-saws in felling service has prompted a reanalysis of data on a time-study of a felling test of the Dow saw. It had been decided previously that the results had better not be published because of the experimental stage of development of the Dow saw. After a more detailed analysis, however, the net effective-time data, - i.e., moving from tree to tree, swamping, net cutting labor, and wedging, - appear to give a reliable indication of probable output exclusive of delay time. A report has been prepared showing both actual performance during the observations and anticipated performance by the new model machines which have been improved to such an extent that the 17.2 percent of study delay time caused by saw and engine trouble should be practically eliminated. The cutting speed of the new model is the same as that of the old and the weight of the unit, 450 pounds, is also the same.

Power-saws were studied on two different areas. Two sets of contract fellers were timed on area 1 only. It had fairly smooth ground but was densely covered with an understory of white fir reproduction which required considerable swamping at times before the power-saw could be moved. Area 2 was broken up by lava outcrops which slowed down power-saw moving. The timber on both areas was much the same in size. About 75 percent of all trees cut were from 30 to 60 inches d.b.h. and less than 2 percent were smaller than 20 inches. Most of the white fir was left standing, so that the cut by species was over 95 percent ponderosa pine.

With total delay time (planning, resting, miscellaneous delays, maintenance of tools by the hand crews, and repairs and adjustments of

California (Continued)

engines and saws by the power-saw crews) of 20 percent for the hand-fellers and 25 percent for the power-saw crews, daily average production would be as follows:

Area 1	Net utilized scale M B.M. per day
2-man contract hand-felling crew	57.8
2-man power-saw crew	77.9
3-man power-saw crew	115.9
Area 2	
3-man power-saw crew	107.9

To give an idea of the difference in net actual cutting speed between hand and power-saw felling on the area studied, the rates below have been calculated on the basis of net undercutting, barking, and sawing by the hand crews and net sawing of undercuts, side-notches (in tree with stumps larger than 50 inches d.o.b.) and main cuts by the power-saw crews:

Area 1	Net cutting rate exclusive of moving, swamping, wedging, and delays. Feet B.M. Net Scale PER HOUR
2-man hand crew	11,407
2-man power-saw crew	30,549
3-man power-saw crew	36,412
Area 2	
3-man power-saw crew	36,990

Northern Rocky Mountain

Christmas Trees. During the month information on Christmas tree production in Montana was furnished members of the Montana Legislature who are proposing a license of $2 for the first 100 trees produced by an operator and 5 cents each for the subsequent production. A canvass of producers indicated that 1,262,500 trees were produced in Montana during 1936 for the commercial trade. This exceeds by almost 100 percent preliminary production estimates and indicates that the Christmas tree harvest is an important industry in some western Montana communities. In Eureka, Montana, a typical "boom and bust" lumbering town, it has become one of the principal industries. Thousands of acres of cutover lands now produce an annual winter grub-stake payroll of approximately $30,000.

Northern Rocky Mountain (Continued)

Logging and Milling. The Diamond Match Company cooperated in the white pine project by manufacturing wood from some of the study trees into match splints. These splints arrived in Missoula recently and will be tested for strength properties. Results of the strength tests will be correlated with tree size and other attributes of the study trees. Receipt of these splints completes the field work of this project.

Lumber Census. Mailing of the first requests to all sawmill operators of record in Montana and northern Idaho was completed January 7. As in previous years, returns obtained by Region Four from mills in southern Idaho will be forwarded to this Station for use in a preliminary tabulation covering the entire State.

Pacific Northwest

Log Depletion in the Douglas Fir Region. The average annual saw-log depletion in the Douglas fir region during the period 1925 to 1929, inclusive, amounted to 6,353,457,000 feet, log scale. Of this, Douglas fir constituted 67.89 percent, western hemlock 16.73 percent, western red cedar 11.16 percent, Sitka spruce 3.45 percent, white fir 0.55 percent, Idaho white pine 0.05 percent, and the hardwoods 0.17 percent. For the year 1929 the depletion amounted to 6,817,487,000 feet, log scale, with Douglas fir supplying 71.82 percent, western hemlock 15.89 percent, western red cedar 9.53 percent, Sitka spruce 2.04 percent, white fir 0.40 percent, Idaho white pine 0.04 percent, and the hardwoods 0.28 percent.

Power Saws in Felling and Bucking. Anderson completed the collection of information on this subject and summarized the results in a memorandum furnished the Pacific Logging Congress. At present there are several promising models of power saws on the market which have met with some success under favorable circumstances. Although these saws have not yet been adapted to conditions in the Douglas fir stands of the Pacific Coast, a number of agencies are concentrating on the problem and it is to be expected that many advances in design will be perfected.

Statistics - Exports. The annual summary of log, round timber and burl exports for 1936 was completed. This is made from Customs data summarized by the Seattle and Portland Merchants Exchanges, and gives the information by species, district of origin, and country of destination in more detail than does any other published summary. Log exports continue to increase, and for most species reached new volumes in 1936. Douglas fir led with 108 million feet, Brereton scale, as compared to 74 million feet in 1935. Oregon supplied about two-thirds of this. Hemlock ranked second in 1936 with 65 million feet, Brereton scale; western red cedar was third with 14 million; cottonwood

and Port Orford cedar fourth with 13 million feet each. Other species of which appreciable footages were exported were white fir 8 million, Sitka spruce 6 million, and western white pine nearly 4 million. By far the greater volume of log exports go to Japan, with China taking the second largest volume.

RANGE MANAGEMENT

Intermountain

Precipitation, Summer Range, 1936. Records taken at the Great Basin Branch Station located in central Utah at an elevation of 8,850 feet, show that annual precipitation for 1936 was 140 percent of the 20-year average. The complete record of precipitation during 1936 and the relation of the 1936 precipitation to the 20-year average are shown in the following table.

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.	June Sept.	Annual
20-yr.ave. (1914-33 incl.)	3.15	2.85	4.11	3.54	2.44	0.85	1.81	1.80	1.56	1.92	2.19	3.26	6.02	29.48
1936	5.58	9.38	3.33	2.54	2.17	2.81	5.63	1.55	1.06	1.94	0.47	4.94	11.05	41.40
1936 in % of the 20-yr.average	177	329	81	72	89	331	311	86	68	101	21	152	184	140

As shown by the table the precipitation during January and February was greatly above normal being 177 percent and 329 percent of the 20-year average. During this period snowfall was the deepest on record. Precipitation during March, April and May was slightly below normal ranging from 72 percent to 89 percent of the 20-year average. The summer thunderstorm period was early and violent resulting in exceedingly heavy precipitation during June and July at which time the totals for these two months were 331 percent and 311 percent respectively of the 20-year average. Amounts dropped below normal in August and September and raised slightly above normal in October after which the annual minimum was recorded for November. Winter storms ensued during the latter part of December which raised the precipitation for this month to 152 percent of the 20-year average.

Owing to the great excess of precipitation during the months of June and July, the seasonal precipitation (June to September inc.) was 184 percent of the 20-year average.

Intermountain (Continued)

Forage Yield, Summer Range, 1936. Forage yield of summer range lands during 1936 as measured by a number of 16 by 16 foot yield plots at the Great Basin Branch Station was 123 percent of the previous 12-year average (1924-1935 inc.) and 138 percent of the 1935 yield.

Range Forage Inventory and Type Map of Utah Nearly Completed. The Intermountain Station has nearly completed a range forage inventory and a vegetational type map for Utah. Some work remains in making the figures jibe with county areas and in copying the type map from the field sheets. The inventory is the result of two field surveys: first, one made in 1932 when parts of all the states in the Intermountain region were surveyed, and secondly, a field survey conducted during 1936, under the leadership of Dr. George Stewart, cooperatively by the Intermountain Station, the Forest Service Region 4, the AAA, the Utah Agricultural Experiment Station, and in a more informal way by the Division of Grazing, Interior Department.

The inventory and type map were based on field data taken on approximately 70 range units. When complete, a forage inventory will be available for each of these range units and for each of 23 of the 29 counties in the State, and will include practically all of the important range areas. Inventory by counties has been difficult in the rough country of south central Utah because range units nearly always cut across county lines.

The survey data will include (1) a vegetational type map, (2) an inventory of the plant cover (3) feed value of the forage, (4) some notes on the erosion conditions, and (5) some notes on plant mortality. Later, a factor of animal-unit days of feed contained in a forage-acre will be added. These data were obtained from replicated plots by the point-observation-plot (square-foot density) method, and are fairly accurate. Unfortunately, the forage acre requirements formerly used by the Forest Service for grazing survey data are not applicable because the point-observation-plot method gives a much smaller figure for plant density than the former method.

Vegetation Survey Method Much in Demand. The article by George Stewart and S. S. Hutchings on "The Point-Observation-Plot (Square-Foot Density) Method of Vegetation Survey" -- Journal of American Society of Agronomy, Vol. 28, No. 9, September 1936, pp.714-722, has been in great demand. All except a few of the 200 printed copies were distributed shortly after publication. Additional requests were so numerous that 500 copies were mimeographed, of which nearly 300 have been mailed and additional requests still are arriving. Demand has been strongest from the Forest Service, Soil Conservation Service, the AAA, Division of Grazing Interior Department, and state colleges.

Intermountain (Continued)

Artificial Reseeding. A general survey of prevailing conditions made during the past year has revealed a wide variety of problems for research.

There are three general types of range lands in need of revegetation in the Intermountain region. These are (1) the high mountain ranges where the growing season is relatively short and where there is usually sufficient precipitation for the production of abundant forage; (2) the foothill and valley edge ranges where the growing season is longer and where rather extended periods of drought may occur; and (3) the desert valleys and ridges where most of the precipitation falls during the winter months and where the season of growth for forage plants is limited almost entirely to the spring months. Owing to the long period of extremely dry and hot weather during the summer on these desert ranges, practically no growth is made by plants at this time.

Since soil development is a function of the climatic influences it is obvious that there would be considerable difference in the soils of these range types, but there is also considerable variation within the soils of each of the range types. It is believed that many of the great soil groups are represented in this region. Podsols or Podsol-like soils have been encountered on some of the more heavily vegetated and forested mountain ranges where the precipitation is relatively high. Chernozem-like soils have been formed on the more favorable grasslands where abundant development of the tall native grasses occurred under natural conditions prior to the days of the big cattle boom in the 1880's Brown and gray-brown soils occur extensively on the foothill ranges, and there are extensive areas of the gray desert or Sierozem soils in the valleys and in the true desert region. Peat and muck soils occur in some of the high-mountain areas where moisture has been abundant, and solonchak soils occur in some of the valleys where conditions have favored the accumulation of alkali salts.

This wide variety of climatic and soil conditions will obviously necessitate a well planned and conducted research program to determine the adaptability of species. To meet these demands additional work centers have been established on national forests near Wells, Nevada and Boise, Idaho, and work is also being centered at the experimental nursery farm near Logan, Utah, and other branch stations.

To study the adaptability of forage species to the various climatic and soil conditions, experimental plots were established and seeded at all of the work centers last fall, and additional plots will be seeded this spring. In addition to planting by reseeding it is also planned to revegetate a number of plots this spring by transplanting various grasses that have been grown in the greenhouse during the winter months. There are some critical watershed areas in the region where it is imperative to revegetate as quickly as possible to

control soil erosion and to develop properly regulated streamflow. Revegetation by transplanting on these areas will undoubtedly hasten the work and it may also prove to be the most satisfactory and economical method.

Northern Rocky Mountain

Utilization of Silver Sagebrush. Silver sagebrush, Artemisia cana, is one of the important browse species of the range lands near Miles City. It is seldom eaten by cattle in the summer time, but in the fall and winter forms an important and nutritious feed. Part of our grazing studies are aimed at determining proper utilization of this species.

Difference in current utilization of grasses and possibly also of the silver sagebrush has been observed by examiners from time to time, but, as an effect of heavy use on these pastures, this is the first definite measurement of a permanent reduction in the forage. The slow rate at which range deterioration appears is one indication of the resistance of shortgrass range forage to heavy use. Reduced calf crop, lesser gains and higher costs of feed per pound of calf weight produced on the overgrazed range have been very marked during the four years of the test. This economic phase of the penalty of too heavy use has been evident from the first, but it is another story in itself.

Summary of Artificial Reseeding Results. Without doubt the past three years have been the most unfavorable for reseeding work in Montana in half a century or more. Precipitation ranged consistently from 40 to 60 percent of normal with 75 percent of normal the rare exception for eastern Montana stations during any of the three years. Two of these seasons have also been characterized by the worst infestation of grasshoppers and crickets known to the section. Only a low percentage of success could be expected from cheap reseeding methods with these major handicaps.

The following tables show relative success of spring and fall reseeding for certain more promising species, based on best data available in the fall of 1936. (See next page.)

The results are based on examinations made in the fall or late summer of 1936, at which time it was impossible to make an accurate appraisal of the success in some cases. Those areas that appeared to be on the border line were classed as failures so that the figures on success are more likely to be revised upward than downward with a favorable season in 1937. In recent examinations a number of fields have been reclassified as successful that were previously classed as failures. No data are available on 159 acres seeded--largely on National Forests--in the fall of 1936.

Fall seeding	All Species °		Crested wheatgrass		Common brome		Slender wheatgrass		Mixtures	
	Total acres	% suc.	acres	% suc.	acres	% suc.	acres	% suc.	acres	% suc.
Coop. areas	405	35	270	46	39⅓	20	19	16	49 1/	18
N.Forest areas	73	37	38	59	½	0			34	14
U.S.R.L. areas	98	15	70	14	2	0	2	46	7	41
Totals	576	32	378	41	42	19	21	16	90 1/	18

1/ Actually crested wheatgrass should be credited with 1% higher success and mixtures with only 12% success because crested wheat was the only survivor on 6 acres of the latter counted as successful.

Spring seeding	All species °		Crested wheatgrass		Common brome		Slender wheatgrass		Mixtures	
	acres	% suc.	acres	% suc.	acres	% suc.	acres	% suc.	acres	% suc.
Coop. areas	678	24	427	32	48	12	13	19	94½	11
N.Forest areas	47	27½	24	32	½	100			22	3
U.S.R.L. areas	83	13	56	17	3⅓	0	3		1½	0
Totals	808	22⅓	507	30½	52	12	16	16	118	9
Grand Totals, Spring and Fall	1384	26½	885	35	94	15	37	16	208	13

° All species includes tall oat, meadow fescue, perennial rye, Kentucky, Canada blue, Lespedeza, and several others.

The relative success of crested wheatgrass is outstanding as compared to all others. Counting both spring and fall seeding, 35% of 885 acres are classed as successful. Fall seeding with 41 percent success on a total of 378 acres has given notably better results than spring seeding with only 30-1/2 percent success on 507 acres. Fall seeding gave equal or slightly higher success for other species also. It, therefore, appears that fall seeding should be favored at least during drought years where little or no soil preparation is done, as is true for most of the acreage covered.

Considering the competition of existing vegetation and the lack of or very slight degree of soil preparation, the success of 59 percent for fall seeded areas on National Forests indicates that reseeding at a low cost is quite feasible on such areas. The same may be said of 46 percent success for fall seeding on a considerably larger acreage of cooperative areas. These are nearly all located below 3500 elevation where the effects of drought and grasshoppers were very severe. The grazing capacity of all the successfully reseeded areas have been increased materially; in some cases several hundred percent.

Even with 46 percent success, with crested wheatgrass at 50 cents or more per pound, it cannot be said that range reseeding is economically feasible for the private owner of depleted range land of very low productivity. With seed at half this price, however, the private owner of the better class of range land could afford to risk 3 to 5 pounds of crested wheatgrass in each of two trials, if necessary, on the chance of increasing the grazing capacity from 100 to 500 percent.

During the past summer twelve pairs of plots were set along a portion of the division fence between a heavily-grazed and lightly-grazed pasture in a very homogeneous site, a heavy-soiled bottomland supporting principally silver sage and Agropyron smithii. The area is practically flat and there is little or no perceptible stock-trailing effect along the fence in either pasture. Each pair of plots had a common side 6 meters in length along the fence, and extended out at right angles for 9 meters into the pastures. Thus the plots sampled only a narrow strip of land and cannot be taken as quantitatively representative of the pastures as a whole, although it may be assumed that they give a fair relative picture of them. Pertinent results are presented in the table below.

	Heavily-grazed pasture	Lightly-grazed pasture
Number of living and dead bushes	180	166
Number of living bushes	64	59
Area of browse (sq. cm.)	2069	4593

The table shows two things rather clearly. First, there has been about a two-thirds reduction in the number of bushes from the recent droughts. Actually, in terms of forage, there has been a greater reduction than this, because the droughts have killed-back a large part of the living bushes also.

The second important thing is that there is more than twice the sagebrush foliage remaining in the lightly-grazed pasture than in the heavily-grazed one. This cannot be interpreted as the result

of current utilization because the bushes were little grazed in 1956, being, as before stated, relatively unpalatable to cattle until cold weather. Considering the population of sagebrush to have been uniform at the start of grazing in 1932, the significance expressed statistically is P = .065. That is, taking into account the variations between plots, the difference favoring the lightly-grazed pasture stands about one chance in fifteen of being accidental, a rather low level for significance, if the population had been uniform. But the heavily-grazed plots were favored at the start by 14 bushes. In 1956, although totalling so much less in area, they still had 5 more bushes than the lightly-grazed pasture. Therefore, inasmuch as the heavily-grazed plots seem to have been allowed a handicap, the odds are better than one in fifteen.

Pacific Northwest

Herbarium Plans. Dr. Edith English arrived from Seattle on January 27 to begin the task of cataloging and rehabilitating the Region 6 herbarium. Nomenclature on more than 5,000 species in the collection will be brought up to date, a record for each species listing the national forests or the approximate localities if not from a national forest area (E. Oregon, W. Oregon, E. Washington, W. Washington) on which it has been collected will be made, a workable card index for the herbarium will be set up and last but not least, a standard plant symbol list based on a 3-letter system will be devised to incorporate all the plants in the collection. This symbol list will be similar to that already in use at the Intermountain Station. Species common to both regions will be given the symbols now in use at the Intermountain in an attempt to begin standardization of a convenient and time-saving range research tool.

Southwestern

Winter Climatic Records. The Jornada Experimental Range received no precipitation in January whereas the Santa Rita received 1/3 above normal in November, nearly 50 percent above in December and 100 percent excess in January, making the 3 winter months run 7.02" compared to a long-time average of 4.44". The Jornada experienced a near low record in temperature at 3°F. and the Santa Rita received a new winter low of 9°F.

Grazing Habits of Cattle on Semidesert Mixed Grass Ranges. In last month's report, the results were given of the study on the Santa Rita on the preference of cattle for different forage plants. The second objective of the study deals with some of the general grazing habits of cattle at different seasons of the year.

Southwestern (Continued)

During the late spring and summer months cattle normally begin grazing about daylight (4:30 to 5:00 o'clock) and continue until about 8:00 or 9:00 o'clock in the morning. The afternoon grazing period starts between 4:00 and 5:00 and continues until dark or after. Occasionally, on moonlight nights in the spring, cattle have been observed grazing as late as midnight. During the winter months grazing starts somewhat later, usually around 7:00 in the morning and continues until about 10:00 o'clock. The afternoon grazing period begins between 3:00 and 4:00 o'clock and lasts until dark.

On the average it requires about 6 to 7 hours of grazing per day for a cow to eat all that she wants. The amount of feed available does not seem to affect the length of the grazing period appreciably, though this factor has not been checked sufficiently as yet. It does, however, seem to have a bearing on the rate at which an animal grazes and on the way in which it grazes individual plants. A scant feed supply causes an animal to graze faster and more persistently, and at the same time rather close to the ground. A plentiful supply of forage leads to more leisurely grazing, as well as to cropping only portions of plants. When feed is plentiful and in cured stage, cattle are also apt to be more selective, grazing certain plants to the exclusion of others.

At the start of the growing season cattle are more inclined to graze anything that is green without any definite selection. Normally, most cattle start moving toward water when they begin grazing in the morning, though there are some individuals that do not go into water until the evening. Still other animals alternate between morning and evening in their watering habits. Generally speaking, when cattle get to the watering place (at the close of the morning grazing period) they water out first then salt and again go to water. After this they lie down in the shade nearby and remain until time for the afternoon grazing period. A few individual animals may alternate between water and salt several times. Ordinarily cows water out in about ten minutes.

It was noted that approximately 15 minutes is required for a cow to eat her fill of salt from compressed salt blocks. Many cows form a habit of monopolizing a block of salt, after they have eaten what they want, by just standing over it for periods of one-half to three-quarters of an hour.

The majority of cows graze as they walk along covering a strip two to four feet wide and from one to one and one-half miles long taking only a small percentage of the available forage. Some individuals graze every bite of available forage on small local areas.

Ordinarily, in the fall, early spring, and sometimes in the early summer, cattle tend to graze more consistently up and down the washes. At other times of the year they are apt to graze pretty much

at random, sometimes across the ridges and washes and at other times up and down the ridges and washes.

It has also been observed that cattle form a habit of grazing on certain portions of the range, and if left to themselves, will continue to graze there until every spear of available forage is consumed, at the same time leaving other portions of the range, on which there is equally good forage, only lightly used.

From the study come the following tentative conclusions:

1. The need for well-distributed watering places to prevent concentration of cattle locally.

2. The need for intensive salting as a means of securing a better distribution of stock.

3. The need for numerous salt grounds to enable all cattle to get salt.

4. The need from the standpoint of more effective management plans for more detailed study of the grazing habits of livestock.

These conclusions are perhaps not new to those who have dealt with range problems; however, they are based on an approach that has been given too little consideration in the past.

Germination Characteristics of Southern New Mexico Range Grasses. Germination tests of common semidesert range grasses in southern New Mexico made annually since 1923 by the Jornada Experimental Range have been compiled in tabular form. The following species have germination percentages of cleaned seed sufficiently high for reproduction, although lower than those of cultivated plants: Andropogon saccharoides, Aristida longiseta, A. pansa, A. purpurea, Bouteloua curtipendula, B. eriopoda, B. gracilis, B. hirsuta, Hilaria mutica, Muhlenbergia arenacea, M. arenciola, M. porteri, Panicum obtusum, Scleropogon brevifolius, and Sporobolus airoides.

The following species have unusually low germination, due mainly to hard seed coats: Panicum hallii, Setaria macrostachya, Sporobolus cryptandrus, S. flexuosus, S. giganteus, S. nealleyi, and Triodia pulchella. Scarifying seeds of Sporobolus spp. increases greatly the percentage of germination.

There is a wide range of variation in percentage of germination among different samples of seeds of the same species. Although these differences may be due in part to conditions under which the tests are made, growth conditions of the plants are partly the cause. Germination is higher when rainfall during the growing season is greater.

Southwestern (Continued)

The number of seeds matured by plants of many grass species is often low. Usually only 1 seed is produced in each 5 or more florets. In drought years the number of seeds may be very low, or none may be produced. In artificial reseeding tests where uncleaned seeds are used, allowance must be made for the percentage of florets or spikelets containing seeds as well as for the germination percentages of cleaned seeds.

Germination of seeds of most grass species in tests is rapid, usually within two or three days for most seeds. However, seeds of Sporobolus spp. with impervious seed coats commonly do not start to germinate until the third or fourth day or later.

These seeds retain their ability to germinate for several years, at least, as seeds 3 to 6 years old showed no loss in viability when tested. Therefore, large quantities of seeds can be collected in years of high precipitation and good seed crops to be stored and planted during the following years, when seed production may be lower or uncertain.

Seeds of these semidesert range grasses can germinate the year of production and do not require a period of dormancy, although tests immediately after seed production are slightly lower than average.

MANUSCRIPTS

ALLEGHENY

Downs, A. A.	Weather conditions during the glaze storm of March 17-19, 1936 in Pennsylvania and New York State. (For Monthly Weather Review.)
Forbes, R. D.	Federal forest research in Maryland forests and forestry in Maryland. (Maryland Development Bureau.)
Hough, A. F.	Natural tree reproduction in the beech-birch-maple-hemlock type. (For Jour. of Forestry.)

APPALACHIAN

Buell, J. H.	Tree families. (Address before the Friendly Dozen Garden Club, Asheville, N. C. January 22.)

CALIFORNIA

Wilson, R. C.	The remnant redwoods of the Santa Cruz Mountains. (For American Forests.)
Aylesworth, Evelyn	A statistical problem in forestry. (For Journal of the American Statistical Association.)

LAKE STATES

Gevorkiantz, S. R.	The approach of northern hardwood stands to normality. (For Jour. of Forestry.)
Gevorkiantz, S. R. and Wm. A. Duerr	A yield table for northern hardwoods in the Lake States. (For Jour. of Forestry.)
Shirley, Hardy	Direct seeding in the Lake States. (For Jour. of Forestry.)

SOUTHERN

Bull, Henry	Tools and labor requirements for pruning longleaf pine. (For Jour. of Forestry.)

Manuscripts (Continued)

PACIFIC NORTHWEST

Anderson, Eric A.	Power saws for felling and bucking. Office memorandum, Jan. 29, 1937.
Kolbe, E. L., Rasmussen, B. L. and Beeman, W. H.	Final report on the timber reconnaissance and mapping of the Blue Mountain Experimental Forest and Range. (Office report.)
----------	Blue Mountain Experimental Forest and Range atlas binder containing stand statistics, type maps, working plans for research projects and other information.
Matthews, D. N.	Region Six fire-danger stations and their equipment. (For Equipment Handbook.)
Morris, W. G.	Early part of thirty-six fall no drier than thirty-two. (For West Coast Lumberman.)

SOUTHWESTERN

Pearson, G. A.	Poisoning conifers in stand improvement and timber sale practice. (For Jour. of Forestry.)
Cooperrider, C. K.	Recovery processes of ponderosa pine reproduction following injury to young annual growth. (To Plant Physiology.)
Culley, Matt J.	An economic study of cattle business on a southwestern semidesert range. Resubmitted to W. O. (F. S. Bulletin.)

IN PRINT

Day, Besse B.	A suggested method for allocating logging costs to log sizes. (Jour. of Forestry, January 1937.)
Forbes, R. D.	Deep in the woods. Forest Leaves (January, 1937.)
----------	Forests and flood control. Forest Leaves, (Oct. 1936.)

In Print (Continued)

Heyward, Frank.	The effect of frequent fires on profile development of longleaf pine forest soils. (Jour. of Forestry, January 1937).
Isaac, L. A.	Highlights of Douglas fir natural regeneration. (Forest Research Notes No. 21, January 2, 1937. Also summarized in Forest Practice Notes of West Coast Lumbermen's Assn.)
----------	How much can we depend upon nature unaided for our reforestation. (Crow's Pacific Lumber Digest, Jan. 30, 1937.) (Crow's Digest printed Research Notes No. 21, giving it this title.)
Laxton, Josephine	Publications - Staff and Cooperators, Appalachian Forest Experiment Station. (July 1, 1921 - December 31, 1936. Technical Note No. 24.)
Lodewick, J. Elton	Log, round timber and burl exports from Oregon, 1936. (Multilithed table)
----------	Log, round timber and burl exports from Washington, 1936. (Multilithed table)
----------	Distribution of Pacific Northwest and Southern pine lumber compared. (American Lumberman, Jan. 2, 1937.)
Munger, T. T. and Wm. G. Morris	Growth of Douglas fir trees of known seed source. (Tech. Bul. 537.)
Osborne, J. G. and V. L. Harper	The effect of seedbed preparation on first-year establishment of longleaf and shash pine. (Jour. of Forestry, Jan. 1937.)
Rudolf, Paul O.	Lessons from past forest planting in the Lake States. (Jour. of Forestry, Jan.1937.)
Snyder, Thos. E.	The termites of Louisiana and their control. (Louisiana Conservation Review, January 1937.)
Stoeckeler, J. H.	Subsoiling increases survival and growth of tree planting in the Great Plains. (Multilithed.)

In Print (Continued)

Wood, O. M. — The interception of precipitation in an oak-pine forest. (Ecology.)

TRANSLATIONS

No. 264. Extracts from "pruning", by Dr. Hans Mayer-Wegelin, 1936. Translated (German) by C. P. deBlumenthal, August, 1936.

No. 265. The effect of early and frequent thinning on the growth of red spruce, by J. A. Løvengreen. From Dansk Skovforenings Tidsskrift, 1935. Translated (Danish) by S. P. Langmack, March, 1936.